ISS Lightning Imaging Sensor and STP-H8/ASAP Observations

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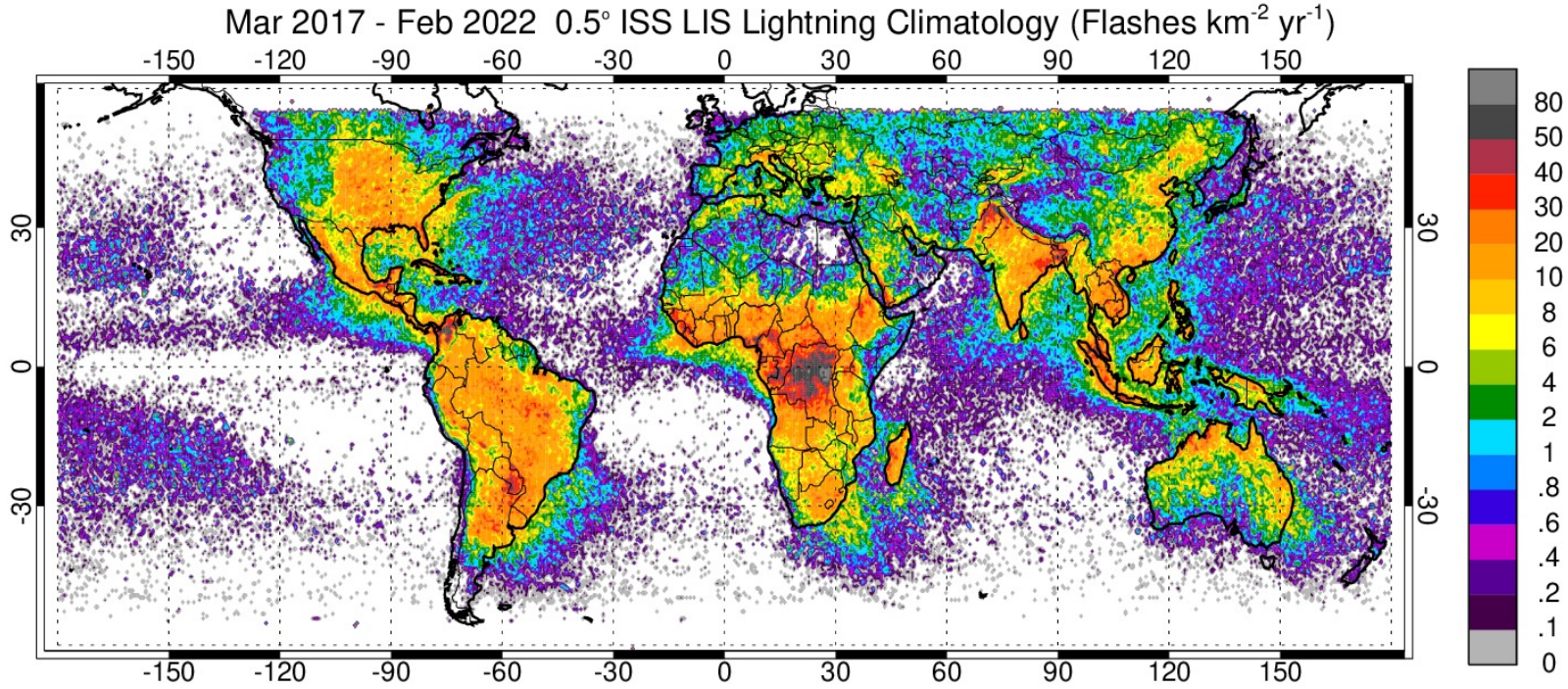
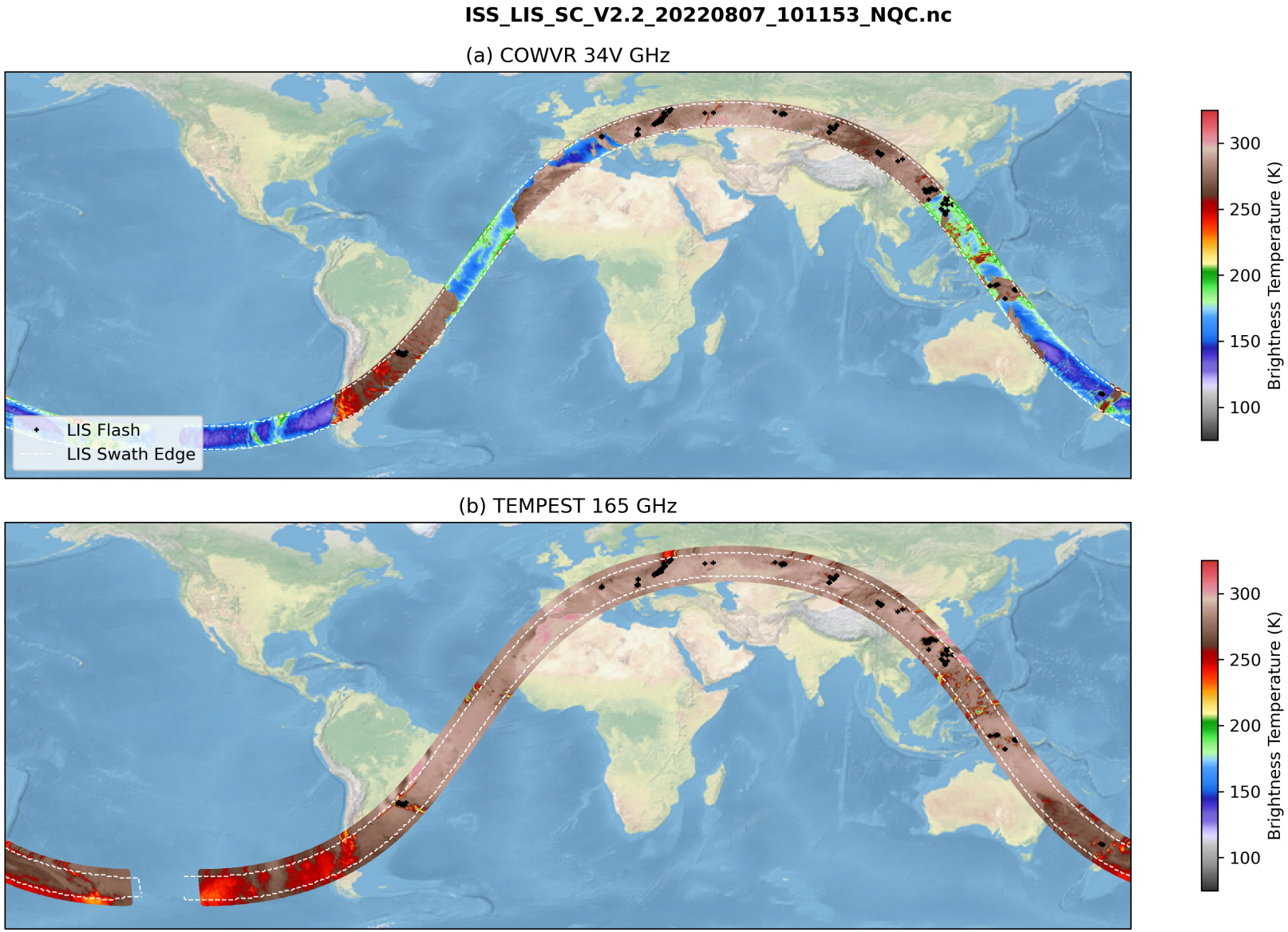
What is ISS LIS?



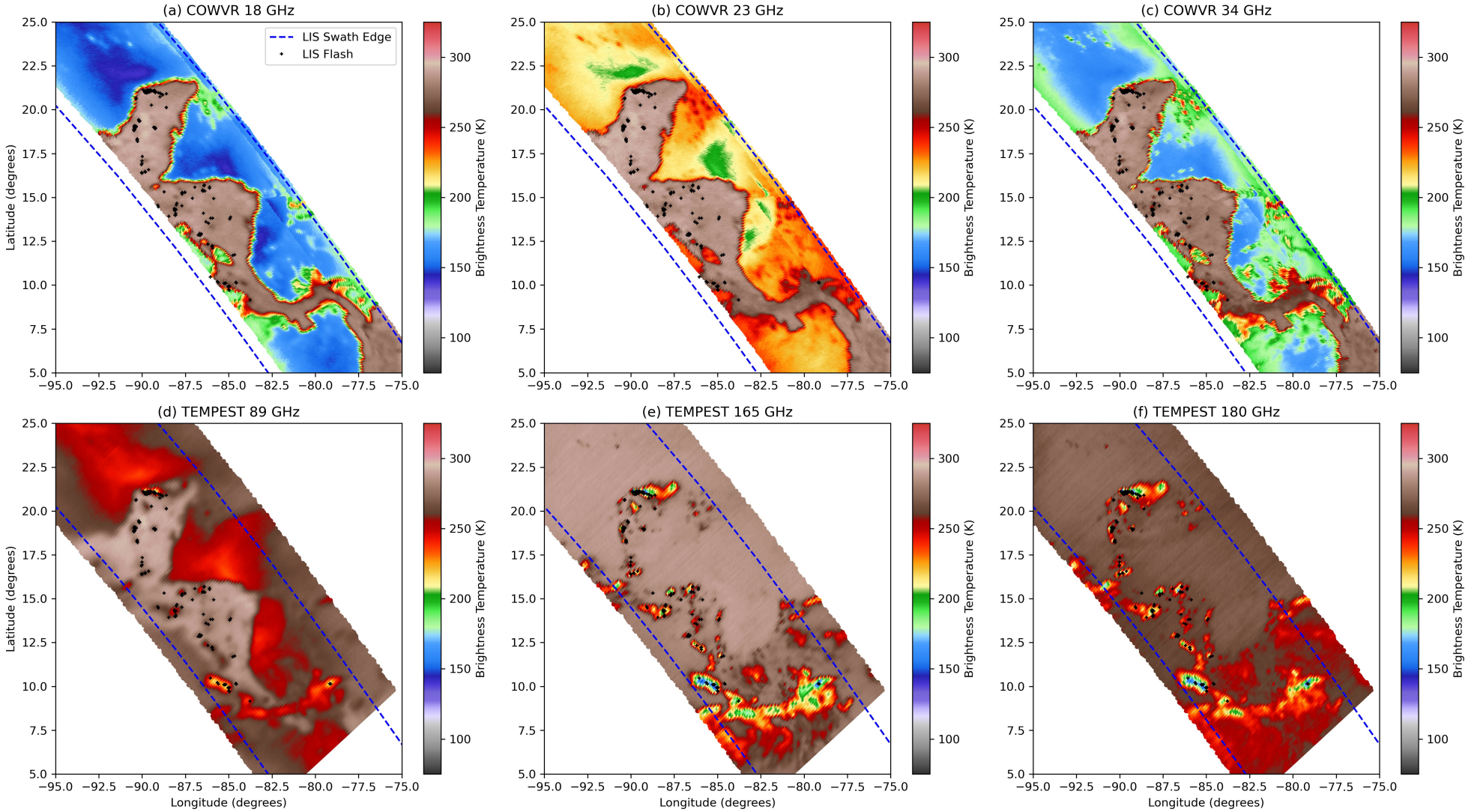
- ISS Lightning Imaging Sensor (LIS) is the flight spare for the Tropical Rainfall Measuring Mission (TRMM) LIS instrument
- Modified to work on ISS and launched as part of STP-H5 in February 2017
- Detects lightning (via near-IR 777-nm channel) during both day and night, with storm-scale resolution and globally uniform detection efficiency
- Relocated on ISS July 2022, expected to operate thru at least December 2023

Combining ISS LIS with ASAP Passive Microwave

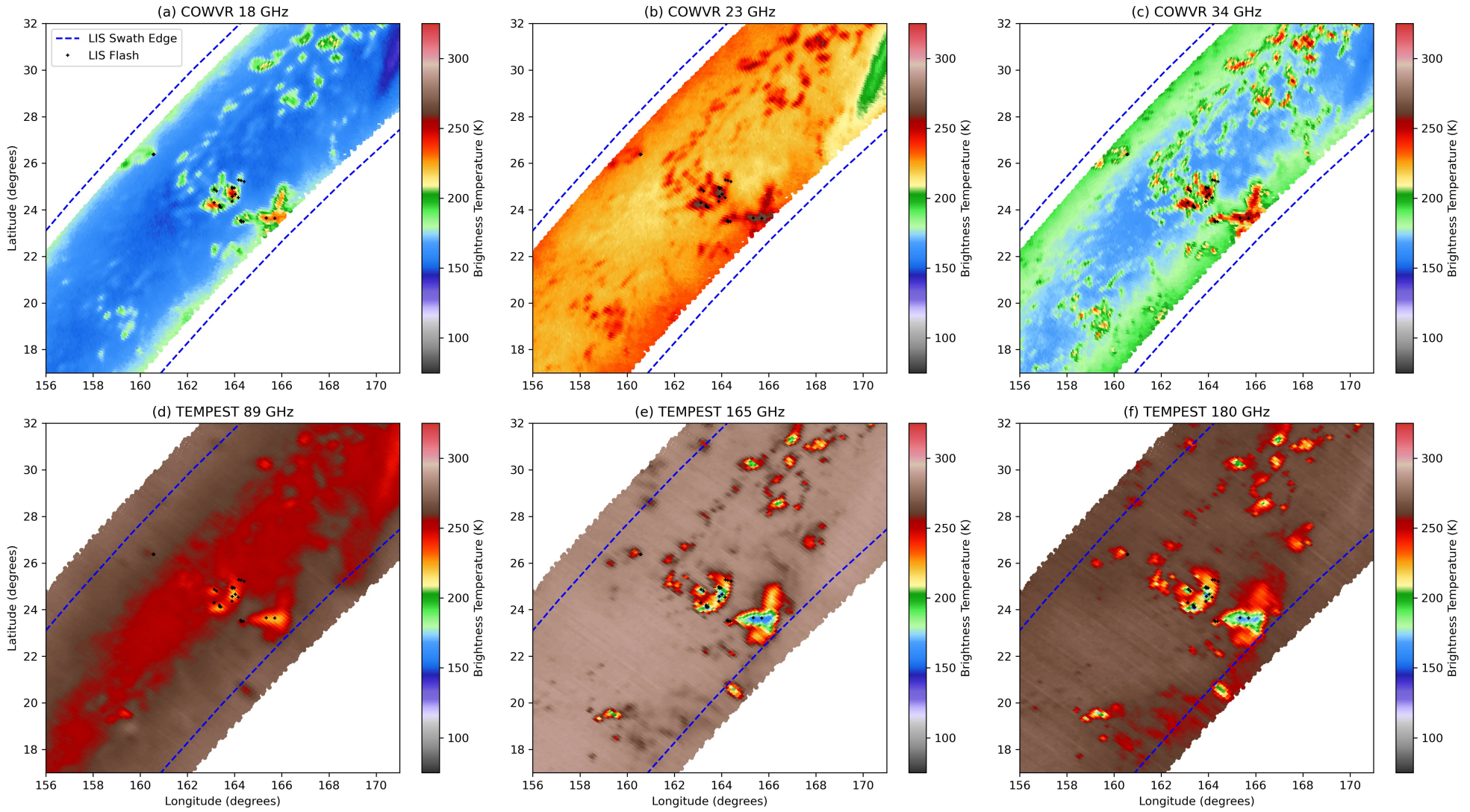
- ISS LIS provides data as ~90-minute orbit granules
- ASAP provides data in hourly files, split between TEMPEST and COWVR
- Developed Python class to merge these different datasets to enable combined plots and statistical analysis
- Note similarity between LIS and ASAP swaths



Over Land Case

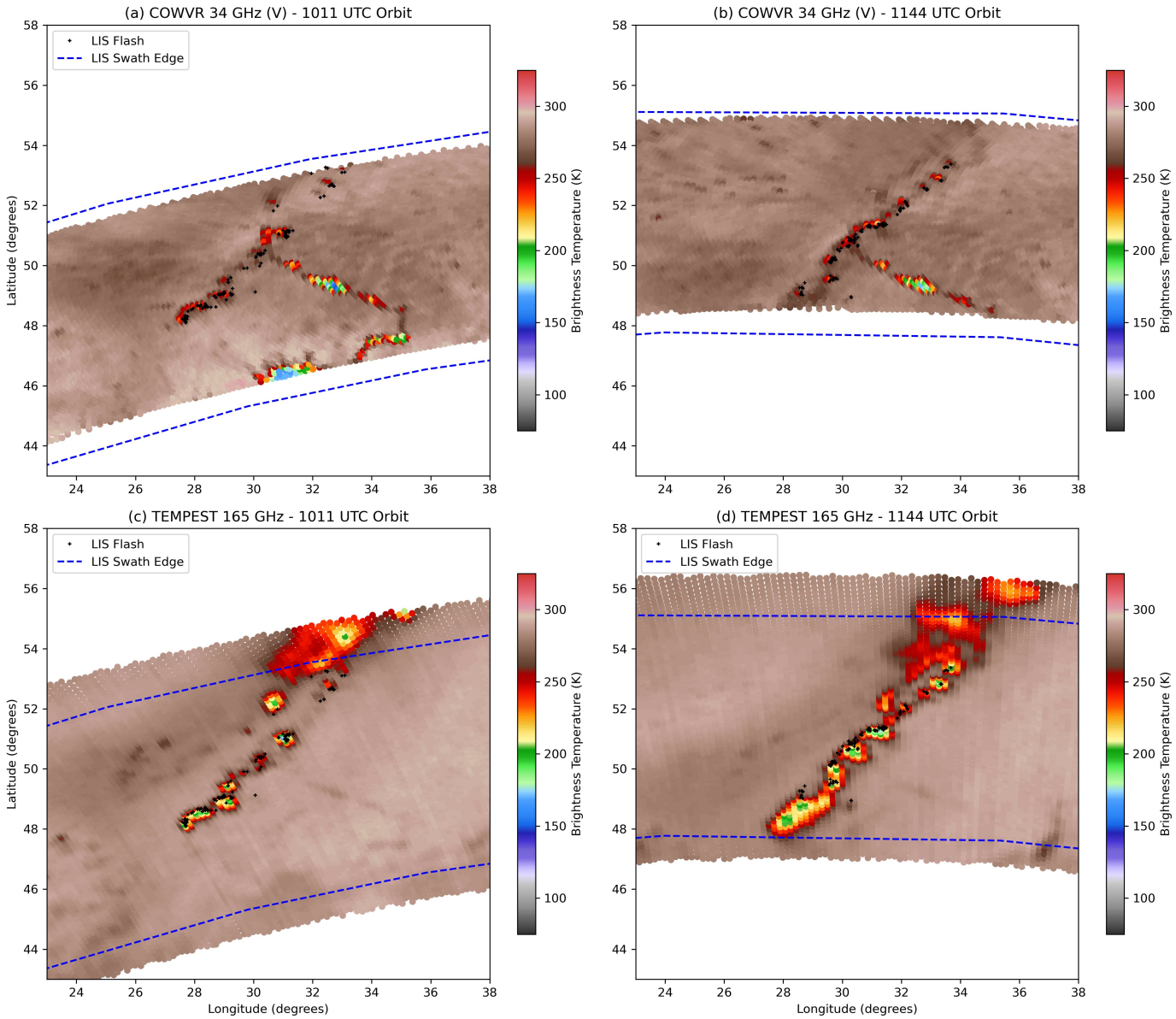


Over Water Case

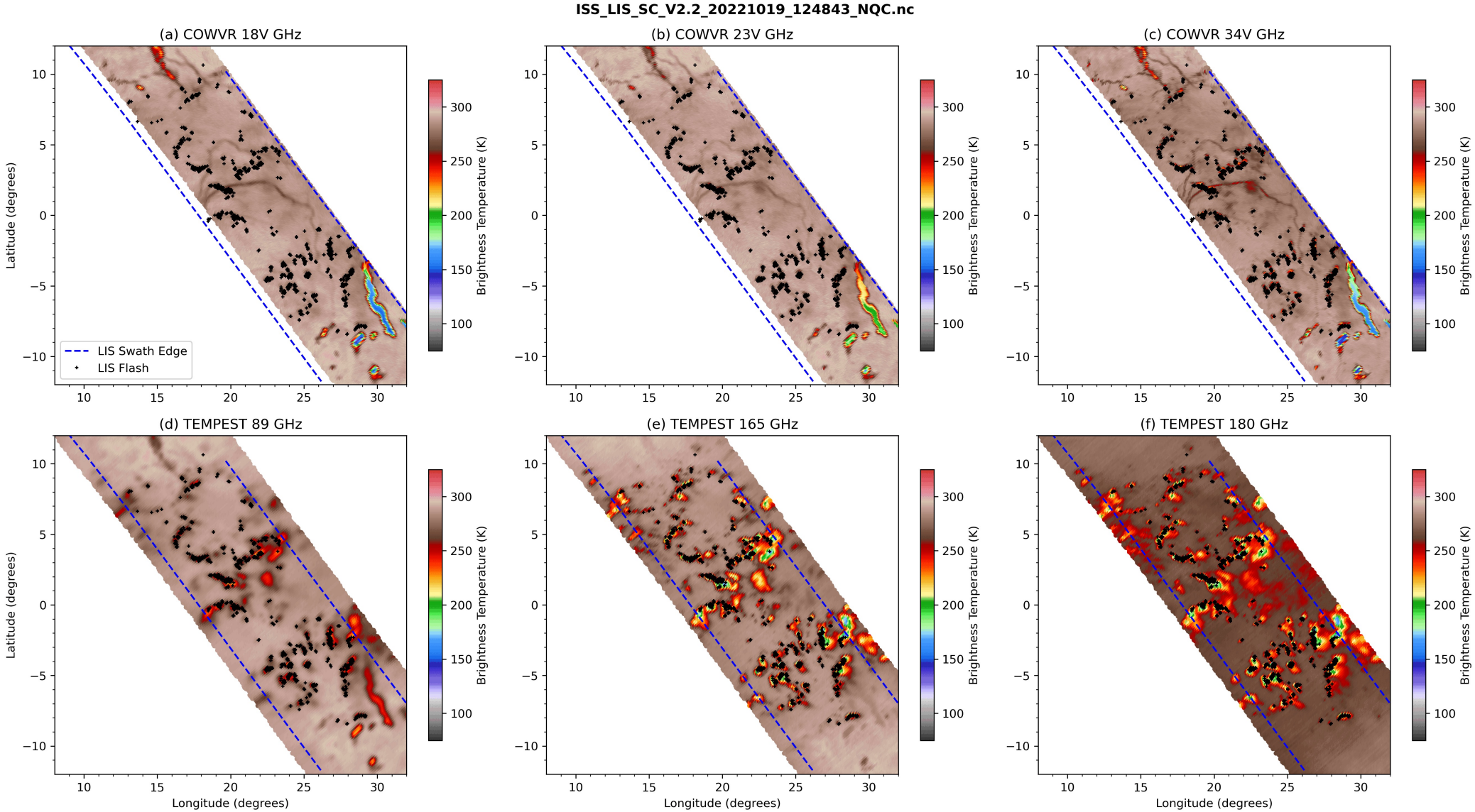


Storm Evolution

- Near high latitudes, ISS often overflies the same location within ~90 minutes
- This enables investigation of thunderstorm evolution, which is particularly useful for mesoscale convective systems (MCSs)
- Example to right shows evolution of MCS over eastern Europe.
- Note how lightning follows the ice scattering signatures in both COWVR & TEMPEST

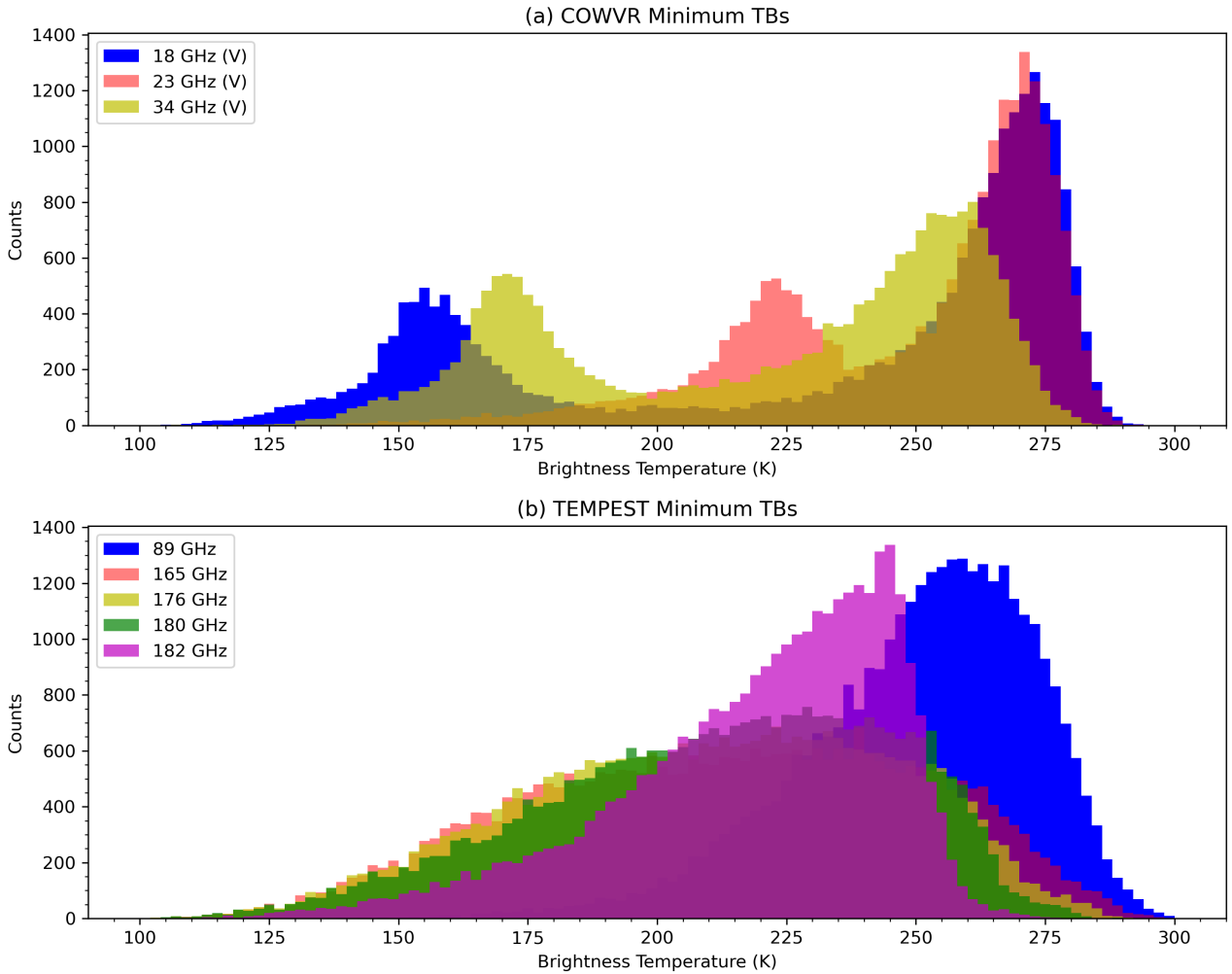


Broad Area of Thunderstorms over Africa – 1300+ flashes in scene



Statistical Analysis

- Minimum brightness temperatures (TBs) near thunderstorms during June-July-August 2022
- Lower frequency COWVR bimodal distribution influenced by land/ocean surface emission TBs, but broad spread suggests influence of ice scattering
- Higher frequency TEMPEST shows much broader unimodal TB distribution, suggesting influence of ice scattering is more dominant than surface emission



Summary and Conclusions

- Combining ISS LIS with STP-H8/ASAP observations reproduces many of the legacy TRMM capabilities, but with additional (mostly higher) microwave frequencies and better coverage of mid-latitudes.

- These combined passive microwave and lightning observations of convection are highly relevant to the future Atmosphere Observing System (AOS), Investigation of Convective Updrafts (INCUS), and the proposed CubeSpark (ISS LIS follow-on) missions.

- Lightning, combined with COWVR/TEMPEST cloud and precipitation retrievals, as well as COWVR ocean vector wind retrievals, enables an unprecedented look at relationships between oceanic convection and boundary layer processes.